PPM 92-300

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Paramax Systems
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Memorandum

PARAMAX
A Unisys Company

PPM-92-300

DATE: Dec. 9, 1992
TO: B. Fafaul/740.4
FROM: K. Sahu KS
SUBJECT: Radiation Report on FAST/HCI
Part No. 2N5196
Control No. 7350

cc: L. Shiflett/745.1
A. Sharma/311
Library/300.1
L. Cusick/740.4
SMEX, PPM File

A radiation evaluation was performed on 2N5196 (Dual N-channel JFET) to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Tables I through IV and Figure 1.

The total dose testing was performed using a Cobalt-60 gamma-ray source. During the radiation testing, six parts were irradiated under bias (see Figure 1 for bias configuration), and two parts were used as control samples. The total dose radiation steps were 5, 10, 20, 30 and 40 krads*. After 40 krads, parts were annealed at +25°C for 168 hours. The irradiation was then continued to 60 krads (cumulative). The dose rate was between 0.07 and 1.0 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested at 25°C according to the test conditions and the specification limits** listed in Table III.

All eight parts passed initial (pre-rad) electrical tests. All irradiated parts passed all electrical tests up to and including the 5-krad irradiation step. After the 10-krad irradiation, three parts (SN 330, 333 and 335) exceeded the minimum specification limit of -25 pA for Igss1 and Igss2, with readings ranging from -26 to -46 pA for Igss1 and -27 to -73 pA for Igss2. After the 20-krad irradiation, all six irradiated parts failed Igss1 and Igss2, with readings ranging from -58 to -225 pA for Igss1 and -62 to -340 pA for Igss2. All six parts continued to fail Igss1 and Igss2 after the 30-krad and 40-krad irradiations,

*The term rads, as used in this document, means rads(silicon).
**These are manufacturers' non-irradiated data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

with readings gradually increasing to a range, after the 40-krad irradiation, of -184 to -1200 pA for Igss1 and -192 to -1800 for Igss2.

Parts continued to fail Igss1 and Igss2 after annealing at 25°C for 168 hours, with readings ranging from -192 to -1110 pA for Igss1 and -146 to -1610 pA for Igss2.

On continued irradiation to 60 krads (cumulative), All six parts continued to fail Igss1 and Igss2, with readings ranging from -460 to -1700 pA for Igss1 and -490 to -3400 pA for Igss2. All parts passed all other electrical tests throughout all irradiation and annealing steps.

After a final annealing at 100°C, no rebound effects were observed.

Table IV provides a summary of the functional test results, as well as the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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TABLE I. Part Information

| | |
|---|---|
| Generic Part Number: | 2N5196 |
| Part Number: | 2N5196 |
| FAST/HCI Control Number: | 7350 |
| Charge Number: | C33112 |
| Manufacturer: | Solitron Devices Inc. |
| Lot Date Code: | 8841 |
| Quantity Tested: | 8 |
| Serial Numbers of Radiation Samples: | 330, 331, 333, 335, 338, 340 |
| Serial Numbers of Control Samples: | 325, 326 |
| Part Function: | Dual N-channel JFET |
| Part Technology: | JFET |
| Package Style: | 6-lead TOx Can |
| Test Engineer: | A. Phung |

TABLE II. Radiation Schedule for 2N5196

| EVENTS | DATE |
|---|---|
| 1) Initial Electrical Measurements | 11/05/92 |
| 2) 5 KRAD IRRADIATION (0.08 krads/hour) | 11/06/92 |
| POST-5 KRAD ELECTRICAL MEASUREMENT | 11/09/92 |
| 3) 10 KRAD IRRADIATION (0.25 krads/hour) | 11/09/92 |
| POST-10 KRAD ELECTRICAL MEASUREMENT | 11/10/92 |
| 4) 20 KRAD IRRADIATION (0.23 krads/hour) | 11/10/92 |
| POST-20 KRAD ELECTRICAL MEASUREMENT | 11/12/92 |
| 5) 30 KRAD IRRADIATION (0.51 KRADS/HOUR) | 11/12/92 |
| POST-30 KRAD ELECTRICAL MEASUREMENT | 11/13/92 |
| 6) 40 KRAD IRRADIATION (0.15 KRADS/HOUR) | 11/13/92 |
| POST-40 KRAD ELECTRICAL MEASUREMENT | 11/16/92 |
| 7) 168 HOUR ANNEALING @25°C | 11/16/92 |
| POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT | 11/23/92 |
| 8) 60 KRAD IRRADIATION (1.00 KRADS/HOUR) | 11/23/92 |
| POST-60 KRAD ELECTRICAL MEASUREMENT | 11/24/92 |
| 9) 168 HOUR ANNEALING @100°C* | 11/24/92 |
| POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT | 12/03/92 |

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT 25°C.

PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

*High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-883D, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of 2N5196

| Test | Conditions | Units | Spec. Limits | |
|---|---|---|---|---|
| | | | Min. | Max. |
| VBRGSS1 | IG=1A, VDS=0 | V | 50 | - |
| IDSS1 | VDS=20V, VGS=0 | mA | 0.7 | 7 |
| VGS1 | VDS=20V, ID=200mA | V | 0.2 | 3.8 |
| VBRGSS2 | IG=1A, VDS=0 | V | 50 | - |
| IDSS2 | VDS=20V, VGS=0 | mA | 0.7 | 7 |
| VGS2 | VDS=20V, ID=200mA | V | 0.2 | 3.8 |
| dVGS | VDG=20V, ID=200mA | V | -.005 | .005 |
| Igss1 | VGS=30V, VDS=0 | pA | -25 | - |
| Igss2 | VGS=30V, VDS=0 | pA | -25 | - |

# TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for 2N5196 1/

| Parameters | | Spec. Lim./2 min | max | Total Dose Exposure (TDE) (krads) 0 (Pre-Rad.) mean | sd | 5 mean | sd | 10 mean | sd | 20 mean | sd | 30 mean | sd | 40 mean | sd | Anneal 168 hrs. @25°C mean | sd | TDE 60 krads mean | sd | Anneal 168 hrs @+100°C mean | sd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VBRGSS1 | V | 50 | - | PASS | | PASS | | PASS | | PASS | | PASS | | PASS | | PASS | | PASS | | PASS | |
| IDSS1 | mA | 0.7 | 7 | 1.59 | .71 | 1.62 | .72 | 1.60 | .71 | 1.60 | .70 | 1.59 | .71 | 1.63 | .72 | 1.60 | .70 | 1.59 | .70 | 1.61 | .70 |
| VGS1 | V | 0.2 | 3.8 | 1.00 | .37 | 1.00 | .37 | 1.00 | .37 | 1.00 | .37 | 0.99 | .37 | 0.99 | .37 | 0.99 | .37 | 0.99 | .37 | 0.99 | .37 |
| VBRGSS2 | V | 50 | - | PASS | | PASS | | PASS | | PASS | | PASS | | PASS | | PASS | | PASS | | PASS | |
| IDSS2 | mA | 0.7 | 7 | 1.59 | .71 | 1.62 | .72 | 1.60 | .70 | 1.60 | .71 | 1.59 | .71 | 1.63 | .72 | 1.61 | .70 | 1.60 | .70 | 1.61 | .71 |
| VGS2 | V | 0.2 | 3.8 | 1.00 | .37 | 1.00 | .37 | 1.00 | .37 | 0.99 | .37 | 0.99 | .37 | 0.99 | .37 | 0.99 | .37 | 0.99 | .37 | 0.99 | .37 |
| dVGS | V | -.005 | .005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Igss1 | pA | -25 | - | -2.2 | .28 | -14 | 3.8 | -27 | 10 | -104 | 62 | -203 | 139 | -462 | 390 | -386 | 366 | -1375 | 1264 | -210 | 166 |
| Igss2 | pA | -25 | - | -2.4 | .32 | -15 | 5 | -34 | 20 | -124 | 108 | -244 | 235 | -569 | 617 | -464 | 568 | -1445 | 1159 | -236 | 168 |

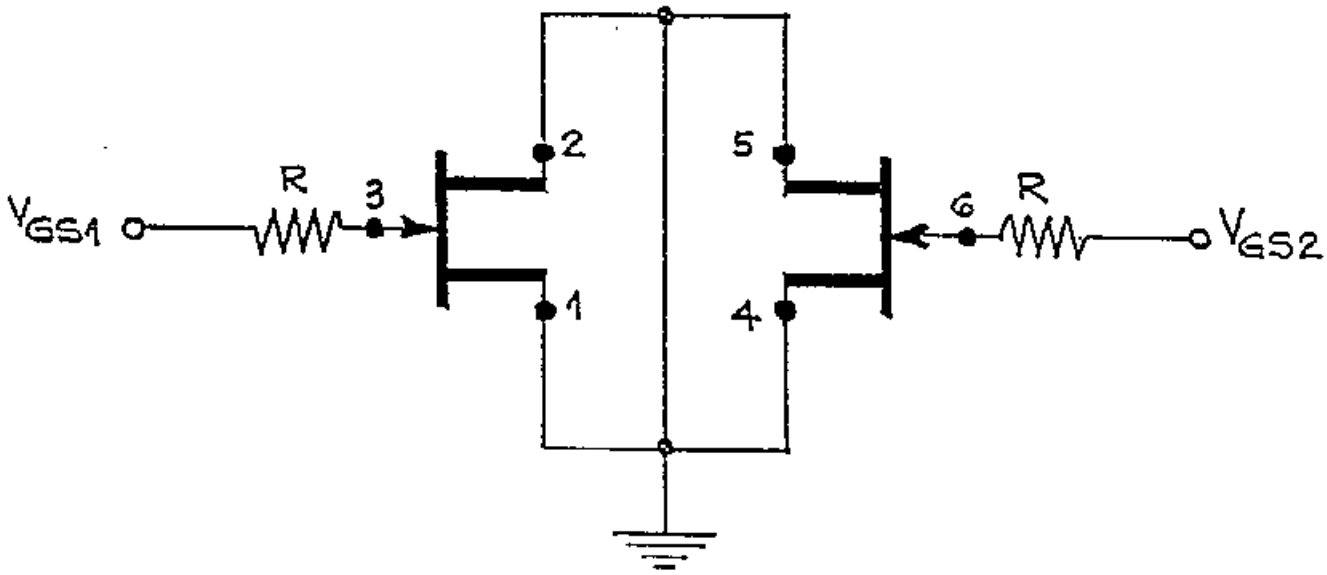
Notes:

1/ The mean and standard deviation values were calculated over the six parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

Figure 1. Radiation Bias Circuit for 2N5196

| | | |
|---|---|---|
| PIN # 1 | : | SOURCE 1 |
| PIN # 2 | : | DRAIN 1 |
| PIN # 3 | : | GATE 1 |
| PIN # 4 | : | SOURCE 2 |
| PIN # 5 | : | DRAIN 2 |
| PIN # 6 | : | GATE 2 |




| | | | |
|---|---|---|---|
| Vgs1 | = | Vgs2 | - 40 V , max |
| Vds1 | = | Vds2 | 0 |
| R | = | 100 Kohm + / - 5 % , 1/4 W | |